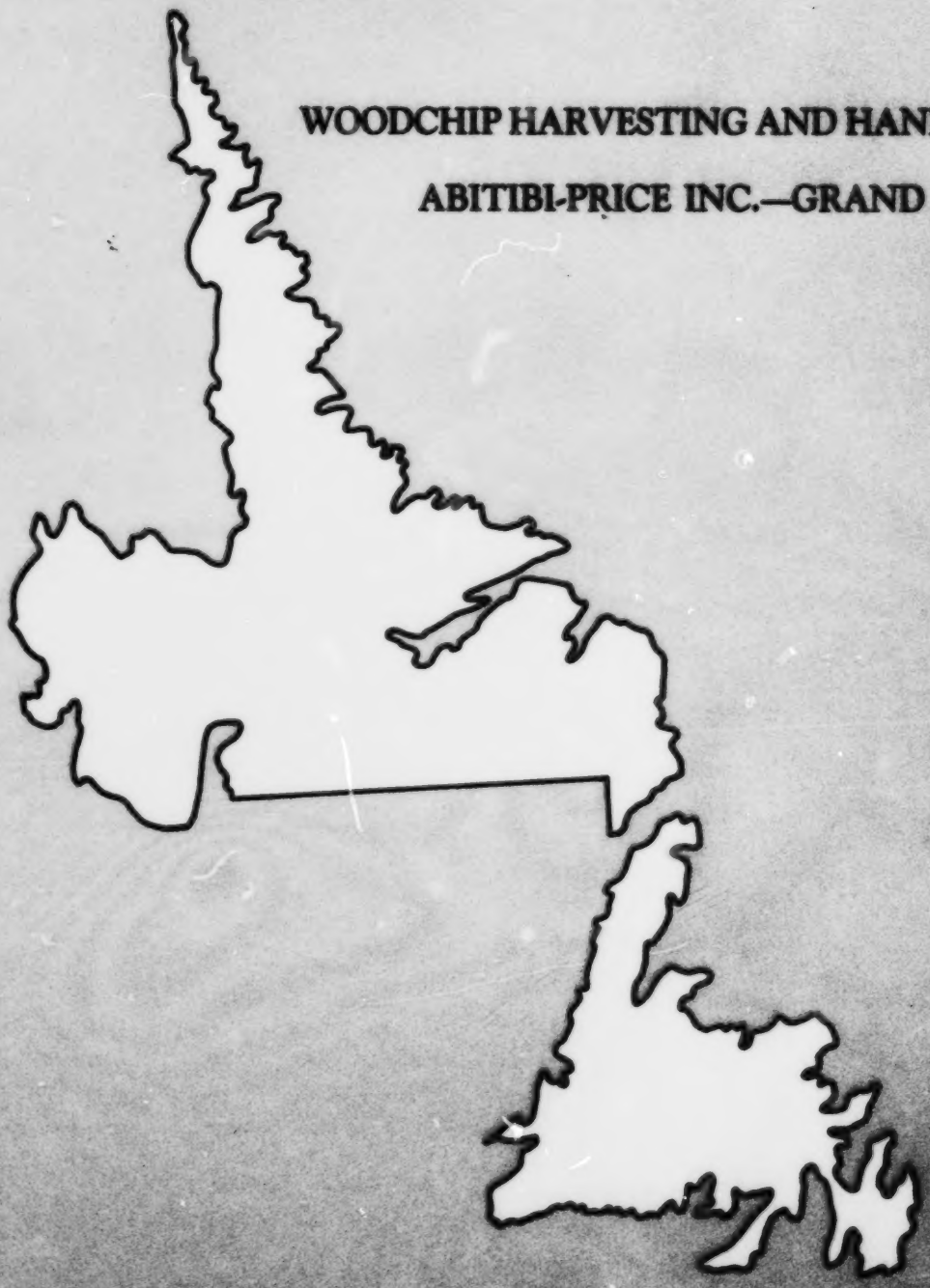
CANADA / NEWFOUNDLAND

CONSERVATION AND RENEWABLE ENERGY DEMONSTRATION AGREEMENT

WOODCHIP HARVESTING AND HANDLING

ABITIBI-PRICE INC.—GRAND FALLS



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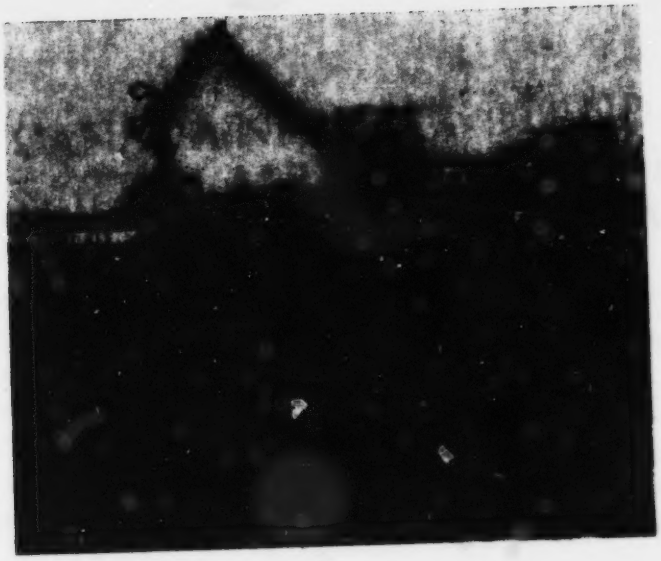
WOODCHIP HARVESTING AND HANDLING ABITIBI-PRICE INC.—GRAND FALLS



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Under Contract With:

Abitibi-Price Inc.
Grand Falls, Nfld.

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CANADA/NEWFOUNDLAND CONSERVATION AND RENEWABLE ENERGY DEMONSTRATION PROGRAM

Because of the sharp increases in the cost of oil, natural gas and electricity within the past 15 years, the search is on for economical sources of energy. Affordable energy, now and in the future, concerns everyone.

In June 1979, to help meet this demand for conservation and alternative sources of energy, the Government of Canada and the Government of Newfoundland and Labrador signed the Conservation and Renewable Energy Demonstration Agreement (CREDA).

The objectives of this $11,250,000 cost-shared program (Federal 80%, Provincial 20%) included the following:

- to develop and demonstrate promising new technologies which use renewable energy resources;
- to develop and demonstrate new and efficient technologies which conserve energy;
- to create employment in new and existing energy related industries;
- to inform the public of the economical use of new technologies as they apply to the energy resources of Newfoundland and Labrador.

The CREDA program ended March 31, 1985. For more information on this and other energy projects funded under the Canada/Newfoundland CREDA program contact:

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PROGRAMME CANADA/TERRE-NEUVE DE DÉMONSTRATION DES ÉCONOMIES D'ÉNERGIE ET DES ÉNERGIES RENOUVELABLES

La montée en flèche du coût du pétrole au cours des 15 dernières années, du gaz naturel et de l'électricité a rendu nécessaire la recherche de sources d'énergie à bon prix. La question de l'énergie à coût abordable, pour aujourd'hui et les années à venir, touche tous les Canadiens.

Pour aider à répondre aux besoins en matière d'économies d'énergie et d'énergies renouvelables, le gouvernement du Canada et le gouvernement de Terre-Neuve et du Labrador ont ratifié en 1979 au Accord de démonstration des économies d'énergie et des énergies renouvelables (ADEEER).

Ce programme a été doté d'un budget de 11,25 millions de dollars, et le gouvernement du Canada et celui de la province s'en partageant les coûts dans une proportion de 80% et 20% respectivement. Quelques-uns de ses objectifs étaient:

—La mise au point et la démonstration de nouvelles techniques prometteuses faisant appel aux énergies renouvelables;

—La mise au point et la démonstration de nouvelles techniques efficaces d'économie d'énergie;

—La création d'emplois dans des entreprises nouvelles ou existantes oeuvrant dans le domaine de l'énergie;

—Faire connaître au public les avantages économiques de ces nouvelles techniques telles qu'applicables aux ressources énergétiques de Terre-Neuve et du Labrador.

Le programme ADEEER prendra fin le 31 mars 1985. On peut obtenir plus de renseignements sur le programme ou sur les sujets qui ont fait l'objet d'une aide financière en vertu de l'Accord Canada — Terre-Neuve sur les économies d'énergie et les énergies renouvelables en communiquant avec:

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Disclaimer

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Abstract
Woodchip Harvesting and Handling
Abitibi-Price Inc., Grand Falls

The testing of improvements in techniques for the production of woodchps from whole trees for commercial fuel, and the installation of a hydraulic dumper for tractor-trailer vans and its effects on production, are described.

Chips harvested from pure hardwood stands were found to be economic, with a heat value of 1.1 barrels of fuel oil per tonne, resulting in a saving of $5.92 per tonne. Integrating pulpwood logging and chip harvesting was not economical.

Changing to mechanical felling produced only small savings. The dumper reduced costs, but did not improve productivity. However it did permit expanded use of waste material as fuel. Experience from New Brunswick indicates that productivity could still be improved.

Rèsumè
La Rècolte et la Manutention des Copeaux de Bois
Abitibi-Price Inc., Grand Falls

Les procèdès d'amèlioration des techniques de production de copeaux de bois a partir d'arbres entiers et destinèe à la fabrication de combustible commercial, l'installation d'un basculeur hydraulique sur les remorques motorisèes, et de son incidence sur la production sont dècrits dans le rapport.

Les copeaux provenant de feuillus purs et qu'ont une valeur èconomique, affichent une valeur calorifique de 1,1 baril de mazout, d'ou une èconomie de 5,92 $ par tonne. L'intègration des activitès d'abattage de bois a pâte et de rècolte des copeaux n'est pas rentable.

Le recours a la mèthode d'abattage mécanique ne donne que des èconomies restreintes. L'utilisation du basculeur hydraulique a permis de rèduire les coûts, sans toutefois amèliorer la productivitè. Par contre, on a utilisè davantage des dèchets comme combustible. L'expèrience acquise au Nouveau-Brunswick indique que la productivitè pourrait être amèliorèe.

ACKNOWLEDGEMENTS

Acknowledgements are due to the staff of Abitibi-Price Woodlands Division, who did the actual work reported, and to Highlands Contracting Ltd. and Warren Strong P.Eng., who carried out the professional work. Much thanks should also be given to the Canada/Newfoundland Conservation and Renewable Energy Demonstration Agreement, for providing funds which made the whole project possible.

This report was edited for CREDA by David Bazeley.

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Energy, Mines and Resources Canada | Energie, Mines et Ressources Canada

Mines & Energy Newfoundland & Labrador

Whole Tree Chipping For Fuel
Abitibi Price Incorporated

CREDA Project

Canada/Newfoundland Conservation and Renewable Energy Demonstration Agreement

Project Location:
Abitibi-Price Pulp & Paper Mill
Grand Falls

Date:
August, 1985

Technology:
Large Scale Wood Heating

Project Manager:
Harvey G. Taylor

Project Number:
03:04:29

Status:
Completed

Sector:
Industrial

Province:
Newfoundland

Purpose:

To demonstrate the harvesting, chipping, delivery and burning of hardwoods as an alternative fuel to Bunker C oil in the newsprint mill at Grand Falls.

Description:

Trials were carried out to compare woodchip production from a variety of forest sources, using different techniques for harvesting and transportation. The chips were used to replace oil at the mill for process steam production.

Contributors:

Abitibi-Price Ltd.	$1,011,390*
Canada/Newfoundland	$ 136,900
Total	$1,148,290

*Cost of chip production supported by other government programs

The chipping operation

Demonstrated Benefits/Savings:

The trials indicated that the use of woodchips is feasible and viable. One tonne of chips replaces 175 litres (1.1 barrels) of No. 6 fuel oil, with a cost saving of $3.53 (in 1984).

The mill could burn a total of 30,000 tonnes of mixed woodchips and sawmill residue each year. This would replace 5.2 million litres of oil, and save Abitibi-Price $106,000. Furthermore, through employment and purchases, $973,800 would be retained in the provincial economy.

Further Information:

A slide presentation and a final report are available from the Department of Mines and Energy.

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Production Superintendent
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Grand Falls, Nfld.
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Energy Branch
Dept. of Mines and Energy
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Phone: (709) 576-2411

INDUSTRIAL COMMERCIAL RETROFIT PROJECT

WHOLE TREE CHIPPING FOR FUEL

Economic Analysis:

Capital Costs	
Hydraulic Van Dumper	$ 38,120
Installation	$ 80,000
Total Installed Cost	$118,120
Monitoring & Technology Transfer	$ 18,780
Total Demonstration Cost	$136,900
Operating Costs	
Value of oil replaced	$1,206,210
Cost of chip production	$1,011,390
Net Savings (total over 3 years)	$ 194,820
Simple payback (dumper cost)	1.8 years

Note: The payback period will be significantly reduced through burning sawmill residue, which is economically deliverable using the dumper. Also, the chip production was experimental, and chipping performance could probably be improved.

Technical Details:

Harvesting system: 4 woodcutters and a 4 Timberjack choker-skidders, or 2 Hydro-Ax feller/bunchers with 1 grapple skidder (this alternative did not provide additional savings to justify capital expenditure);

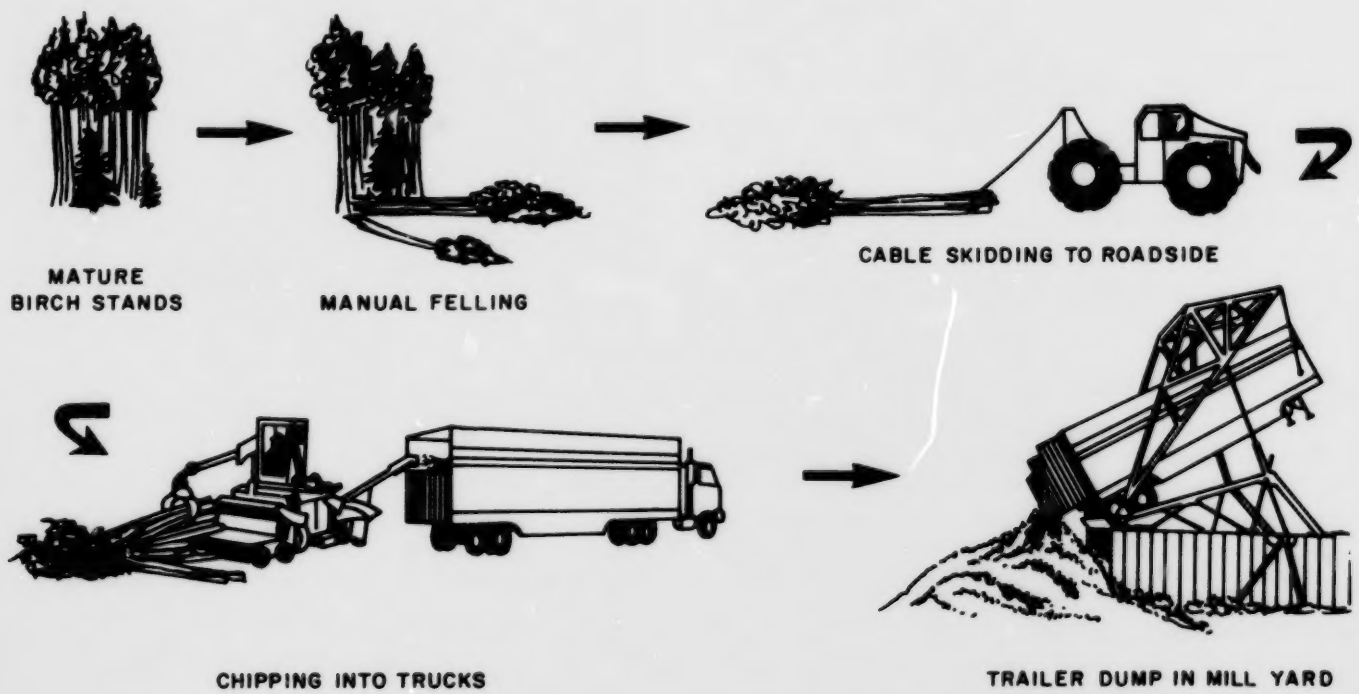
Chipping: at central landing in logging area, using Morbark 22 chipper, discharging directly into chip vans;

Transportation: standard 20-tonne capacity tractor trailer units with enclosed van trailers, unloaded at mill on Morbark hydraulic dumper, and front-end loader for moving chips within mill yard;

Maintenance: 1 D-6 tractor for roads and landings;

Chip Production Rate: Average Fall rate 160 tons/day. This was well below rates achieved in New Brunswick, although chips were still cost-effective.

Whole Tree Chipping for Fuel



EXECUTIVE SUMMARY

This report covers the trials of a variety of improvements in techniques for the production of woodchip fuel from whole trees, carried out between 1981 and 1984 by Abitibi-Price Limited for their paper mill in Grand Falls, Newfoundland.

The trials included: harvesting from stands of pure hardwoods using manual felling and choker wheeled skidders, in different numbers, and using a mechanical feller-buncher; integrated pulpwood logging and chip harvesting from waste and residual hardwoods; chipping a previously stockpiled supply of mixed wood; and converting from modified dump trucks to tractor-trailer vans to transport the chips, with the installation of an hydraulic dumper to unload the vans at the mill.

The following conclusions were drawn:

- that chips can be produced economically from pure hardwood stands, with any of the systems tried;
- that the mechanical feller-buncher did not increase savings sufficiently to justify its capital cost;
- that the chipvan dumper did result in savings, but did not improve productivity, though it was perceived as being more efficient;
- that the dumper permitted greater use of waste materials from outside sources, such as sawmills, for fuel;
- that production rates achieved in Newfoundland were still well below those of New Brunswick;
- that woodchips can be used for commercial fuel, being equivalent to 1.1 bbl of fuel oil per tonne of chips, providing savings, at 1982 prices, of $5.92 per tonne; and
- that the integration of pulpwood logging and chip production was uneconomic at the production rates achieved.

Further investigation was recommended for the integrated logging operation, and in the direction of improving production rates.

INTRODUCTION

BACKGROUND TO THE PROJECT

Previous Trials

Since the summer of 1978, Abitibi-Price Inc. has carried out a number of trials of whole-tree chipping in the immediate area of its Grand Falls mill. These trials were done in conjunction with the the Canadian Forestry Service and the Province's Department of Forest Resources and Lands, and served to establish operational techniques and costs for producing wood chips from a number of types of stands, from pure hardwoods to undisturbed mixed woods. In addition, the integrated logging of undisturbed mixed woods, and the salvage of hardwood from mixed wood cutovers, were recommended by Wilton (1981) for continued investigation.

The trials had provided considerable opportunity for the evaluation of a complete system for producing chips for fuel. The components of the system were:

* manual felling
* forwarding whole trees to a central landing with choker rigged, wheeled skidders
* chipping with a Morbark 22 Chipharvester
* transport in modified dump trucks and tractor-trailer vans

The evaluation highlighted the problem of unloading tractor-trailer vans with a front-end loader. This was described as "The greatest production obstruction in the whole operation" (Wilton, 1981).

PROJECT OVERVIEW

Agreement

In 1981, an agreement between Abitibi-Price and the Canada/Newfoundland Conservation and Renewable Energy Agreement (CREDA) was signed. This agreement was for a

project to demonstrate whole-tree chipping for fuel in the commercial sector.

In New Brunswick, hardwood chips have been successfully produced since 1973 by Valley Forest Products. Their production rate averaged 300 tonnes per day, well in excess of rates achieved by the earlier trials in Newfoundland. The general thrust of the demonstration project was to improve the production rates achieved in this Province. It would focus on the techniques employed in the woods, and improvements in the transportation and handling components of the overall system, and consequently reduce the cost per tonne of the chips.

Objectives

The specific objectives of the project were:

1. To develop further the operational techniques tested in earlier trials, in particular, integrated harvesting, and harvesting from pure hardwood stands; and
2. To install an hydraulic trailer dump, in order to improve transportation, and overall productivity.

Emphasis was to be placed on the production of chips from whole trees from pure hardwood stands. Harvesting techniques and utilization standards had been addressed adequately in the previous trials.

Project Financing

Abitibi-Price and CREDA were the only participants in the project. CREDA contributed $136,900 to the costs, of which $129,000 was earmarked for capital expenditures, primarily the trailer dumper system. The remainder was for project monitoring, data collection and reporting. The contribution of the company was in the form of operational cost coverage. Calculated from the final data, this was in the region of $920,000, plus some costs involved in conducting test burns.

The project budget included the retaining of Highlands

Contracting Ltd. to provide the data analysis and reporting functions.

Demonstration Value

There are a number of large-scale commercial and utility sector users of oil in the province, some of which are located within short distance of harvestable timber. This project was intended to demonstrate to these users the potential of wood chip use for the replacement of oil, though obviously this would not be limited solely to within the Province.

PROJECT ACTIVITIES AND OBSERVATIONS

PRODUCTION OPERATIONS

Harvesting Areas

Harvesting was done in two areas: Stoney Brook and Frenchman's Road. In addition, stockpiled wood at Red Cliff was chipped. The locations of these areas in relation to the mill are shown in Figure 1.

Stoney Brook. This was a stand comprise almost entirely of of white birch (Betula papyifera Marsh.), with small quantities of trembling aspen (Populus tremuloides Michx.) and black spruce (Picea mariana (Mill.) B.S.P.). Also present in small numbers were non-commercial species such as pin cherry (Prunus pensylvanica LF.), red maple (Acer rubrum L.), speckled alder (Alnus rugosa (Du Roi) Spreng.), and willow (Salix spp.).

The stand, which originated after a fire, was approximately 400 hectares on slightly rolling terrain, sloping gently towards Stoney Brook, a tributary of the Exploits River. The soils are mainly stone-free, well-drained, clay loams, with scattered surface boulders. It was considered an average growing site, with a Class 4 to 5 forest capability rating. The mean diameter of trees 6 cm in diameter at breast height (dbh) and over, was 9.3 cm, well below the acceptable limit for pulpwood.

The stand was approximately 5 km from the mill.

Frenchman's Road. This was a stand of undisturbed mixed wood, selected for the integrated logging trials. It was 70 years old, of white birch and balsam fir (Abies balsamea (1) mill.) in equal quantities. Other species were present in small quantities.

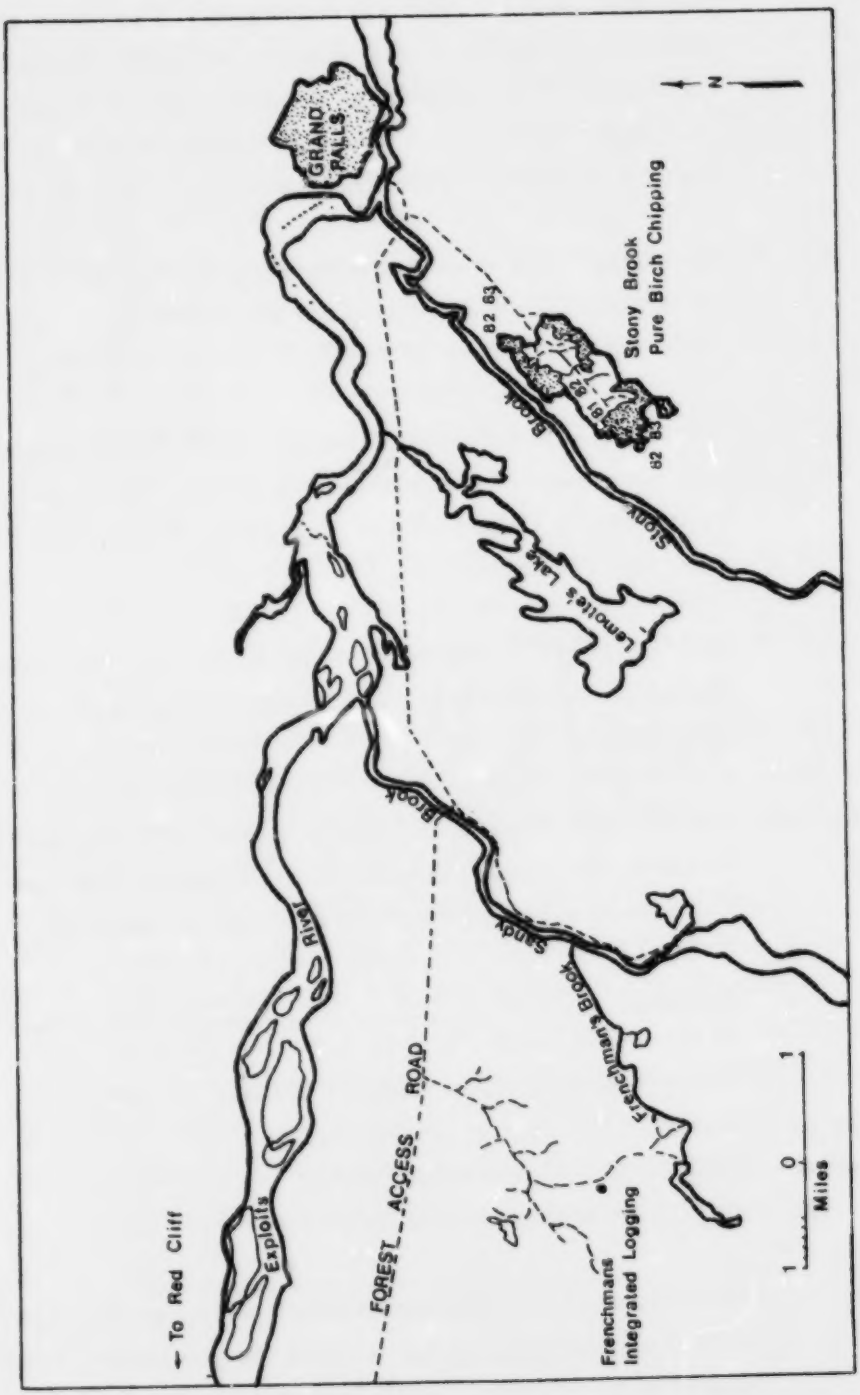


Figure 1. Locations of the Harvesting Areas.

The area was located approximately 6 km from the mill, on generally flat terrain along the south mid-slope of the Exploits. The soil was stoney, sandy loam, with good drainage. The forest capability ranged from 3 to 5. The stand was fully stocked with trees averaging 14.7 cm dbh.

Red Cliff. This area was originally a 75-year old mixed stand of white birch and balsam fir, with some other species. Pulpwood was cut in 1978.

The soil was a coarse, stoney, sandy loam, with generally good drainage. It was situated on uneven terrain along the upper north slopes of the Exploits, beyond the Frenchman's Road cutting area.

The residual trees were cut prior to the start of the project. Consequently, only stockpiled wood was chipped at this area.

Harvesting and Chipping

The initial system utilized manual felling, and forwarding to a central chipping platform by choker wheeled skidders. The complete equipment list is given in Table 1.

Table 1. Equipment Used, 1981

Equipment	No.	Operators
Jonsered Chainsaws	8	4
Timberjack 230 choker wheeled skidders	4	4
Morbark 22RXL total chipharvester with Barko 160 hydraulic loader	1	1
White tandem dump trucks (modified)	3	2

In 1981, each skidder was teamed with two cutters. In 1982, this was changed to one cutter per skidder. Productivity appeared to be equal, with less manpower, since five skidders and five cutters were employed that year.

The felling and skidding aspects of this operation were quite satisfactory, with a minimum of mechanical breakdowns. However, when the ground conditions were soft, the trees received at the chipper were quite muddy. This caused a lot of problems with the chipper.

The main breakdowns suffered by the chipper were shaft breakages and clutch failures. Also, anvil replacement was required more frequently than should be the case. In an attempt to solve the shaft and clutch problems, the main drive shaft was extended, and a pillow block fitted to take the strain.

Discussions with Valley Forest Products led to the conclusion that the major cause of the problems was the mud and debris picked up by the trees as they were being skidded to the chipper. Valley Forest Products had evolved its system from choker skidders and grapple skidders, to their current operation with Koehring feller-forwarders. This delivered clean trees to the chipper, and mechanical failures were greatly reduced.

In early 1983, Abitibi-Price experimented with its own modified system. A Hydro-Ax Model 411 B Feller-Buncher was used to cut and pile bundles of whole birch, which were then pulled to the chipper with a single-long choker.

A summary of the operations is given in Table 2.

Table 2. Summary of Operations

Location	Operation Type	Start (week ending)	Finish (week ending)
Stoney Brook	Pure birch	26-6-81	21-11-81
Frenchman's Road	Integrated logging	3-10-81	24-10-81
Red Cliff	Stockpile Chipping	9- 1-82	20- 2-82
Stoney Brook	Pure Birch	3- 7-82	11-12-82
Stoney Brook	Hydro-Ax Trial	12-2-83	12- 3-83
Stoney Brook	Chipvan Dumper Trial	16-6-84	1- 9-84

The area was located approximately 6 km from the mill, on generally flat terrain along the south mid-slope of the Exploits. The soil was stoney, sandy loam, with good drainage. The forest capability ranged from 3 to 5. The stand was fully stocked with trees averaging 14.7 cm dbh.

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Stoney Brook	Chipvan Dumper Trial	16-6-84	1- 9-84

TRANSPORTATION

Original System

The dump trucks were another source of problems, often causing delays to the chipping operation. It was felt that this situation would be much improved with the installation of the chipvan dumper at the mill.

Hydraulic Chipvan Dumper

The dumper consists of two main parts, a ramp, and the dumping unit itself. The ramp was built of concrete, with an elevation of 3 metres, leading to a concrete platform on which the hydraulic dump unit was installed. The dimensions of the ramp and platform are shown in Figure 2.

The construction was delayed for some time by a dispute over the use of an outside contractor to build the ramp. It was eventually built by mill employees.

The hydraulic dump was constructed by Morbark Industries Inc. in Winn, Michigan. The total system comprises two units, the actual dump with main lift cylinders, attachment chains, pivoting cradle and foundation kit, and a 50hp, 75 gallon pump stand with 2620 V, 12A-12 double pump with control valves, tank, electric motor, motor base, drive and starter. The operating sequence is shown in the photographs in Appendix H.

Since the chips simply piled up beneath the dumper, a front-end loader was required to move them to the mill's residue intake.

WOODCHIP BURNING

A controlled test burning was done at the mill on September 3, 1982. Samples were also sent to consultants for independent analyses.

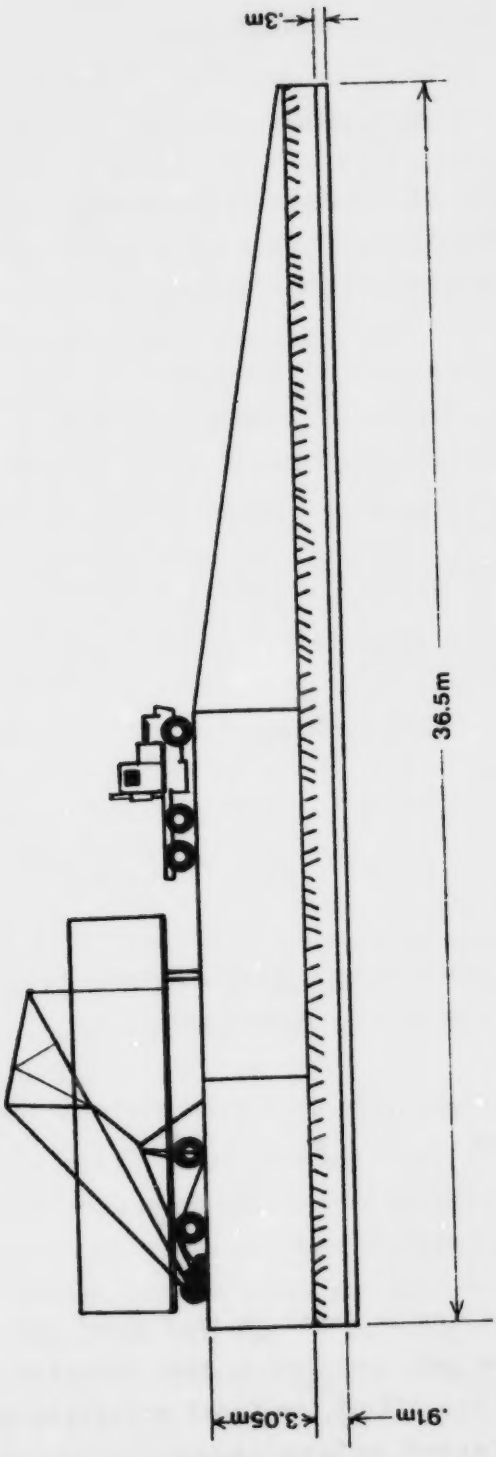


Figure 2. The Chipvan Dumper and Ramp

RESULTS

SUMMARY

A summary of the results achieved is presented in Table 3. The comments which follow should be borne in mind in the interpretation of the results.

Trial Loc'n	Duration Wks/Hrs	Production tonnes	Downtime (hrs) Total	Mech.	Truck Delays
Stoney Brook 81	17/664	10825	203.0	101.5	51
Frenchman's Road 81	4/134	1159	71	33	6.5
Red Cliff 82	5/152	1650	72	16	16
Stoney Brook 82	23/904	14,610	307	173.5	21
Stoney Brook 83[1]	4/160	3280	n/a	n/a	n/a
Stoney Brook 84[2]	11/424	4694	n/a	n/a	38

Table 3. Summary of Results

Notes 1. The hydro-ax/grapple skidder trial.
2. The chipvan dumper trial.

More complete data on system performance are presented in Appendix A.

COMMENTS

Stoney Brook 1981 (Chipping Pure Birch)

The production achieved in this trial was reasonable at 130 tonnes per day, considering that downtime due to mechanical failures was 15% of the total scheduled hours. Waiting for trucks caused delays amounting to another 7.7%. For comparison, Valley Forest Products achieve around 300 tonnes per day chipping pure birch.

Frenchman's Road 1981 (Integrated Logging and Chipping) This trial of the integration of logging for pulpwood and chipping of waste and residual hardwoods was curtailed after only four weeks, due to very adverse weather and ground conditions. The total downtime was the highest of any of the trials carried out under the project at 53%, almost half of which had mechanical causes. Plugging of the chip spout was also significant. Overall productivity was poor.

Red Cliff 1982 (Stock-pile Chipping) The inventory of whole trees previously left at Red Cliff was chipped during the first six weeks of 1982. Actual production was quite low overall, with major delays being caused by moving and waiting for trucks.

Stoney Brook 1982 (Chipping) Pure Birch) The second trial at Stoney Brook gave much the same results as the first, with production averaging 129 tonnes per day overall. This was achieved with two less personnel, by adding one more skidder, and changing to one cutter per skidder. Time lost waiting on trucks was reduced from 3 hours per week to 1, but other waiting time was up significantly.

Stoney Brook 1983 (Hydro-Ax Trial This trial was carried out using one Hydro-Ax and one choker wheeled skidder. It achieved the highest production rate at 164 tonnes per day. Information on related downtime was not collected.

Stoney Brook 1984 (Chipvan Dumper Trial) This trial was carried out to collect data on the effectiveness of the chipvan dumper. Overall productivity was low, at 88 tonnes per day. Detailed data on downtime were not recorded, but the total was high at 46% of scheduled hours. Of this, 9% was due to waiting on trucks. This compared reasonably with the figure achieved at Stoney Brook in 1981, but not with the 1982 figure. The site of the operation was approximately 15 km further (i.e. away from the mill) up Stoney Brook from the earlier operations.

COMPARISON OF CHIPVAN DUMPER AND DUMP TRUCK OPERATIONS

There were many variables in the cutting and chipping operations which could not be controlled, or even quantified. Primary among these were the weather conditions and the quality of the stand and terrain. Another uncertainty factor was the accuracy of the waiting time recordings. These were done only to the nearest half-hour. Given these factors, the comparison could not be considered conclusive.

Production Rates

In Table 4, the production rate of the chipvan trial is compared to rates achieved previously.

Table 4. Production Rate Comparison for Chipvan Dumper Trial

Trial	Production Rates		
	t/sched. hr.	t/prod. hr.	t/wk.
Chipvan Dumper (Stoney Brk 84)	11.1	20.7	426.7
All 81/82	15.2	21.6	532.9
Stoney Brook 81/82	16.2	24.0	669.3
Stoney Brook 10-7-82 to 4-9-82	18.1	25.1	701.4

As well as carrying out the complete trial operation, observations were recorded at the dumper site. The original modified dump trucks could transport 10 tonnes of chips, and dump it in approximately 5 minutes. In comparison, the tractor-trailer vans could carry 20 tonnes, but the cycle time of the dumper was about 15 to 20 minutes

The data show that the production rate during the chipvan dumper trial was inferior to that of all other trials, even though the rate achieved during the equivalent time of year in 1982, using the dump trucks, was the highest. To attribute this directly to the chipvan dumper would probably not be

reasonable, for a number of reasons.

In addition to the time lost waiting for trucks, there was a considerable amount of downtime due to other causes, especially when compared to the equivalent period in 1982. The effects of these delays, in terms of restarting operations, could not be assessed.

Another possible factor is the close proximity of the Stoney Brook stand to the mill. This may well have magnified both the slightly longer cycle time for using the dumper compared to the trucks, and the effects of using a smaller number of 20 tonne vans than of 10 tonne dump trucks. On a longer haul, the benefits of using the vans would be expected to be more significant.

WOODCHIP BURNING

Test Burn

A test burn of the chips was carried out at the Grand Falls mill on September 3, 1982. A heating value of 6.296×10^6 J/kg (5787 BTU/lb) was found for the green chips, resulting in an equivalence to oil of 1.1 bbl/tonne.

Laboratory Analyses

Samples of the chips were sent to two consultants for independent analysis. The results of these were 5.502×10^6 J/kg (5057 BTU/lb) and 5.512×10^6 J/kg (5069 BTU/lb), both equivalent to approximately 0.96 bbl/tonne.

The letters of confirmation for these results are included as Appendix B.

COST-BENEFIT ANALYSIS

COSTS

Data Source

Cost information was obtained from the Company's Cost Control Reports. These used set "rental" rates for all equipment, which was assumed to cover capital cost, interest and repairs. Also included, in addition to direct costs, were costs for operator transportation and road maintenance.

Summary of Costs Incurred

The costs incurred in the various trials are summarized in Table 5. More complete information is included in Appendix C.

Table 5. Summary of Costs Incurred

Trial	Total Production	Total Cost	Cost per tonne
Stoney Brook 1981	10,825 t	$212,762.93	$19.65
Frenchman's Int. 1981	1159 t	$43,606.17	$37.61
Red Cliff 1982	1650 t	$30,353.80	$18.39[1]
Stoney Brook 1982	14,610 t	$279,725.96	$19.14
Stoney Brook 1983 (Hydro-Ax)	3280 t	$61,304.00	$18.69
Stoney Brook 1984 (Dumper)	4694 t	$72,423.20	$15.43

Note 1. This was the cost of chipping and transportation only. The felling and stockpiling was costed at an additional $10 per tonne.

Although these costs show a range of $15 to $19 per tonne to produce chips at Stoney Brook, the repairs to the chipper and the trucks were not really indicated until the year-end statement was produced by the company (see Appendix D). This resulted in an average delivered cost per tonne of $26.64.

This figure was used for the general cost-benefit analysis which follows, since it was considered indicative of the true cost of an ongoing operation, including as it did the high costs of the Red Cliff operation.

Benefits

In September 1983, Abitibi-Price was paying $29.60 for a barrel of Bunker C delivered to the mill. With an equivalence of 1.1 bbl/tonne of chips, the following calculation shows the savings to the Company:

1.1 barrels @ $29.60	=	$32.56 per tonne
1 t of chips, delivered	=	$26.64
Saving per tonne	=	$ 5.92

The savings on the actual cost of chips from Stoney Brook would accordingly be somewhat greater.

Since the cost of "renting" the equipment was included as a direct cost, these prices are based on a zero payback period.

COMPARISON OF MANUAL FELLING AND HYDRO-AX HARVESTING COSTS

The overall cost of chip production at Stoney Brook in 1982 was $19.14 per tonne, compared to $18.69 using the Hydro-Ax and one choker skidder. This was not considered to be a sufficiently large saving to warrant the investment required for a full feller-buncher operation.

Using the data collected in the trial, an analysis was done of the probable production and savings realizable with a system of two Hydro-Ax units, teamed with a grapple skidder. The predicted saving over the manual fell, choker skidder operation was $1.03 per tonne at 750 tonnes per week (see Appendix E). Again, this was considered insufficient incentive to invest in the equipment required.

COMPARISON OF CHIPVAN DUMPER AND DUMP TRUCK OPERATIONS COSTS

Company Chip Production

Although the production rates achieved during the Stoney Brook 1984 trial were well below those of earlier years, the cost comparison was more favorable. The delivered cost per tonne was reduced from $19.14 in 1982 (or $18.53 for the equivalent period of the year) to $15.43. These figures are in actual dollars, so since 1982-83 was a time of reasonably high inflation, the saving was in fact more.

One reason why the costs may have been lower in 1984 was the change from choker wheeled skidders (5), to one Timbco Harvester, This gave rise to lower operating costs, but the genuine saving of transport units should also have contributed.

Use of Other Fuel Sources

The installation of the dumper permitted Abitibi-Price to save money and oil by purchasing other wood residues from outside sources, for example local sawmills. By the end of August 1984, this program was well under way, with a total of 6400 tonnes of residue having been bought, at a delivered cost of $23.00 per tonne (planned to reach 10,000 tonnes by year-end). This had the additional benefit of injecting nearly $150,000 into the local economy, improving the competitiveness of sawmills and increasing employment.

Some local residues would have been purchased without the installation of the dumper, but nothing like the scale now achievable would have been possible.

Payback

The total cost of the dumper system was $118,120, of which $80,000 was for the construction of the ramp (see Appendix F for the purchase cost of the dumper). However, with all the uncontrolled variables, it was felt that any cost-benefit analysis on the unit, based on company-produced chips would have been misleading. It was possible to show the results of

the installation of the dumper only on the basis of an annual use of chips from all sources.

Average cost of chips, including both company-produced and purchased supplies, and all operating and overhead costs $32.46/tonne
Annual consumption (1985 estimate) .....30,000 tonnes
Annual total cost $973,800
Replacement of oil @ 1.1 bbl/tonne.....33,000 bbl
Value of oil replaced @ $32.72/bbl (1984/5)...$1,080,000
Annual total saving.....$106,200

This relects a simple payback period on the dumper of 1.1 years. In addition, since most of the cost of oil at the mill goes out of the local economy, almost all of the $973,800 cost of the use of chips could be considered as a new benefit to that economy.

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

Achievement of Objectives

In terms of the original objectives, the project was considered successful. The techniques tested in earlier trials were developed further, including the experimental use of a mechanical felling and bunching system. The chipvan dumper was also successfully installed at the mill, and a trial operation carried out to provide data for comparison to the previously used dump truck system.

Sufficient data were collected to enable conclusions to be drawn concerning the effectiveness of most of the aspects tried during the project.

Chipping Pure Birch Stands for Fuel

It was concluded that pure birch stands in central Newfoundland can be harvested and chipped for less than $20 per tonne (1982 prices) using manual felling, choker wheeled skidders, and modified 10 tonne dump trucks.

The use of a Hydro-Ax feller-buncher provided some cost savings. However, these were not sufficient to justify the capital investment required for such a system. Likewise, a change to one grapple skidder for two feller-bunchers did not appear to be justified from cost projections.

Changing the transportation system (to 20 tonne tractor-trailer chipvans, unloaded by a hydraulic chipvan dumper) reduced costs, but increased the apparent time the chipper had to wait for a truck Overall production rates were also lower. Whether this was due to other uncontrolled variables was not determined. The chipvan dumper was perceived as more efficient by the operators involved.

The chipvan dumper did allow the Company to make much greater use of outside sources of residual wood fuel, such as sawdust. This in itself was beneficial, both to the Company in the oil savings realized, and to the local economy in the market provided for waste materials. The $80,000 cost for the dumper ramp was considered higher than it should have been.

The production rates achieved were still well below those achieved chipping pure birch (for pulp) in New Brunswick. The reasons for this difference were not identified, but may involve the use in that Province of feller-forwarders, which deliver clean whole trees to the chipper.

Even at the production rates achieved, the chips delivered to the mill did provide a cost-effective replacement of fuel oil, at 1.1 barrels per tonne, with a saving of $5.92 per tonne. These figures were all derived with 1982 dollars. The saving was calculated using the "full" cost of the chips of $26.64 per tonne.

Integrated Logging and Chipping

Integrated logging was not an efficient way to obtain woodchips for fuel, at the production rates achieved. However, the trial was adversely affected by weather conditions, and was curtailed after only four weeks.

RECOMMENDATIONS

Use of Woodchip Fuel

It is recommended that the use of woodchips produced from pure birch stands be continued at as high a rate as possible. It is also recommended that the use of residual wood fuel from outside sources be continued and expanded.

Further Investigation

It is recommended that further investigation take place in two areas: the improvement of all production rates for chip harvesting, with the goal of equalling if possible the rates achieved in New Brunswick; and the evaluation of integrated

logging and chip harvesting, which may become more economic with improved production rates.

REFERENCES

Wilton, W.C. Integrated logging for production of pulpwood and hog fuel, ENFOR Project P-143. St. John's, Newfoundland: Canadian Forestry Service. 21pp; March 1981.

APPENDIX A

SYSTEM PERFORMANCE DATA

TABLE 9
SYSTEM PERFORMANCE BREAKDOWN CHIPPING ONLY
STONEY 1981-82 AND RED CLIFF 1982

	Mechanical			Non - Mechanical						
Week Ending	Sched Hours	Total Down-time	Mech Total	Total	Other Waiting	Trucks	Skidders	Spout Plugs	Moving	Weather
Jul. 4/81	32	17.5	9	8.5	1.5	3		4		
Jul. 11/81	40	11.5	5	6.5		1		5	.5	
Jul. 18/81	40	15.5	7	8.5				6	2.5	
Jul. 25/81	40	28.5	25	3.5		2.5		1		
Aug. 1/81	40	6	.5	5.5	1	4	.5			
Aug. 8/81	40	6.5	3	3.5		2.5	1			
Aug. 15/81	40	19.5	17	2.5		2.5				
Aug. 22/81	40	13	6	7		6.5		.5		
Aug. 29/81	40	5.5	1	4.5		3.5	.5	.5		
Sep. 5/81	40	5.5	3	2.5			2.5			
Sep. 12/81	32	6	3	3		2	1			
Sep. 19/81	40	9	2	7		3	3	1		
Sep. 26/81	40	12	1	11		3	2	4	2	
Oct. 31/81	40	14	2	12		9		3		
Nov. 7/81	40	9	4	5		5				
Nov. 14/81	40	11	8	3		.5		2.5		
Nov. 21/81	40	13	5	8		3	1	4		
Jan. 9/82	24	12	2	10		8			2	
Jan. 16/82	40	26	8	18		2				16
Jan. 23/82	40	28	3	25	1.5	6			1.5	16
Jan. 30/82										
Feb. 6/82	40	6	3	3	3					
Feb. 13/82	8									
Feb. 20/82										
Jun. 26/82	40	10		10	10					
Jul. 3/82	32	9	6	3	3					
Jul. 10/82	40	15	5	10	10					
Jul. 17/82	40	20	18	2	2					
Jul. 24/82	40	40	40							
Jul. 31/82	40	25	23	2	2					
Aug. 7/82	40	40	40							
Aug. 14/82	40	13	13							
SUB-TOTALS	1,128	447	262.5	184.5	34	67	11.5	31.5	8.5	32

TABLE 9
(Cont'd)

Week Ending	Sched Hours	Total Down-time	Mech Total	Non - Mechanical					
				Total	Other Waiting	Trucks	Skidders	Spout Plugs	Weather Moving
Aug. 21/82	40	2		2	2				
Aug. 28/82	40	5	2	3	3				
Sep. 4/82	40	7	2	5	5				
Sep. 11/82	32	5		5	5				
Sep. 18/82	-								
Sep. 25/82	40	7	1	6	1	3	2		
Oct. 2/82	40	13	9	4		2	2		
Oct. 9/82	40	17	3	14	4	5	1	4	
Oct. 16/82	40	9	5	4		2	2		
Oct. 23/82	40	9		9		5	4		
Oct. 30/82	40	9		9	1	2	6		
Nov. 6/82	40	7		7	1		6		
Nov. 13/82	40	9	4	5		2		3	
Nov. 20/82	-								
Nov. 27/82	40	13		13	1.5		9.5	2	
Dec. 3/82	40	14		14	14				
Dec. 11/82	40	9	2.5	6.5	6.5				
TOTALS	1,720	582	291	291	78	88	44	40.5	40.5

TABLE 10
SYSTEM PERFORMANCE BREAKDOWN INTEGRATED LOGGING
FRENCHMAN'S 1981

	Mechanical			Non - Mechanical						
Week Ending	Sched Hours	Total Down-time	Mech Total	Total	Other Waiting	Trucks	Skidders	Spout Plugs	Moving	Weather
Oct. 3/81	35	12	3	9		2.5		4	2.5	
Oct. 10/81	35	22	7	15				7		8
Oct. 17/81	24	9		9	3	3		3		
Oct. 24/81	40	28	23	5	1	1		3		
Totals	134	71	33	38	4	6.5	--	17	2.5	8

APPENDIX B

RESULTS OF TEST BURNING

ABITIBI-PRICE

Inter-office Correspondence

Date : 10th September 1982

To : D.D. Munro

At : Grand Falls

From : E.A. Robbins

At : Grand Falls

Subject : TRIAL BURN OF BIRCH CHIPS ON 3RD SEPTEMBER 1982

On Friday, 3rd September 1982 a trial to indicate the amount of steam produced from burning birch chips in #4 boiler was undertaken.

A stock pile of 12 truckloads or 108 tonnes of chips with an average moisture of 44.1% was used in the trial. The trial lasted for a period of 4 hours during which time the total steam produced was 781,260 lbs. During the trial Bunker C was also used and the steam produced from Bunker C was 119,530 lbs. The steam from Bunker C is based on 65% efficiency due to the excess air being used on the boiler during the trial. Normally the Bunker C is credited with 85% efficiency before the steam from bark or chips is credited.

Based on 65% efficiency the lbs. of steam produced from chips 781,260 - 119,530 = 661,730 lbs. of steam which gives

$$\frac{6127}{5255} = 1.16 \text{ bbls. per tonne}$$

or 1.28 bbls. per short ton.

Using 85% for the Bunker C then the equivalent bbls. of oil for 1 tonne of birch chips becomes 781,260 - 156,310 = 624,951 lbs. which gives 5787 BTU/lb. of chips or 1.1 bbls. per tonne of chips or 1.2 bbl. per short ton.

It is proposed to make another trial with chips only to eliminate the Bunker C influence from the calculation.

E.A. Robbins.

EAR:CAC

cc: H.B. LeValliant
G.N. Cater
F.H. Duquette
H. Taylor
Files

Warnock Hersey Professional Services Ltd.
120 Elmslie Street LaSalle P.Q. H8R 1V8 (514) 366-3100 Telex 055-66245

1000 90 1978

Report No. C-1097

November 3rd, 1981.

Price (NFLD) Pulp & Paper Ltd.,
P.O. Box 500,
Grand Falls, New Foundland A2A 2K1

Attention: Mr. R. Molloy

RE: Analysis of wood chips
for heating value.

Dear Sir,

We have completed the analysis on the sample of wood mentioned above with the following results.

Moisture %	42.6
B.T.U./lb. Dry Basis	8830.4
B.T.U./lb. as rec'd	5068.6

We are pleased to have been of service to you, and we remain,

Yours truly,

P.C. Tewari,

Approved by:

L. Salm, P. Chem,
Manager,
Chemical Dept.

PCT/ch

J. T. DONALD CONSULTANTS LIMITED

CONSULTING ENGINEERS & CHEMISTS

33 CROCKFORD BOULEVARD, SCARBOROUGH, ONTARIO M1R 3B7 TELEPHONE 751-3230

November 9, 1981

REPORT OF ANALYSIS

LABORATORY No. 81-943

of sample of Wood Chips

Marked Your P.O. #052336

Received from Price (Nfld.) Pulp & Paper Limited
Grand Falls, Newfoundland
A2A 2K1
Attn: Mr. R. Molloy

On Oct. 27/81

Moisture	43.1%
Higher Heating Value, BTU/lb.	
As Received Basis	5057
Dry Basis	8887

J. T. DONALD CONSULTANTS LIMITED

G. Auld, M.C.I.C.

GA/wf

B-3

APPENDIX C

OPERATION COST DATA

TABLE 2
COST TABLE
STONEY BROOK OPERATIONS 1981
CHIPPING PURE BIRCH STANDS

Week Ending	Chipper	Chip Trucks	Skidders	Bus	Shunter	Super-visor	Road Maint	Fuels & Lubes	Supplies	Misc	Benefits	Totals	Total Tonage	Cost Ton
June 27/81						160.94	2,837.21	820.51		234.15		4,052.81		
July 4/81	649.27	1,204.54	4,545.28	209.83	120.00	536.45	1,730.51	1,262.10		610.68		11,068.66	259.50	42.65
July 11/81	1,372.30	1,863.83	5,681.60	262.35	150.00	536.45	1,141.60	1,226.73	52.73	368.98		12,856.57	799.26	16.09
July 18/81	1,164.71	1,508.42	5,520.80	262.35	150.00	550.05	1,022.80	2,200.64	716.70	695.41		13,791.88	581.28	23.73
July 25/81	507.01	654.55	2,232.44	172.70	60.00	268.98		2,290.49		216.63		6,402.80	269.88	23.72
Aug. 1/81	1,385.66	1,669.24	5,667.20	283.53	150.00	550.05	545.12	566.14		543.75		11,360.69	861.54	13.19
Aug. 8/81	1,392.34	1,652.89	5,719.60	283.53	150.00	550.05	797.00	2,225.36		571.59		13,342.36	840.78	15.87
Aug.15/81	856.64	963.73	4,575.68	226.82	120.00	536.45	396.00	280.94	243.76	406.73	1,001.30	9,608.05	487.86	19.69
Aug.22/81	1,191.44	1,475.36	5,617.76	283.53	150.00	536.45	534.60	2,220.21		523.31	1,271.45	13,804.11	716.22	19.27
Aug.29/81	1,421.04	1,625.59	4,665.74	283.53	150.00	536.45	1,014.87	669.79		773.09	1,212.24	12,352.34	726.60	17.00
Sept.5/81	1,392.34	1,762.89	4,435.12	283.53	150.00	536.45	571.48	2,270.97	180.96	432.83	1,069.61	13,086.18	757.74	17.27
Sept.12/81	1,078.10	1,351.02	3,903.92	226.82	120.00	429.16	417.04	1,133.69		381.50	936.14	9,977.39	570.90	17.48
Sept.19/81	1,252.78	1,507.60	5,346.40	283.53	150.00	630.14	701.42	1,647.52	84.40	513.30	1,254.34	13,371.43	695.46	19.23
Sept.26/81	1,158.03	1,476.66	5,197.12	283.53	150.00	643.74	684.96	666.22	210.00	501.56	1,224.02	12.195.84	612.42	19.91
Oct.31/81	1,109.28	1,450.31	5,340.70	283.53	150.00	536.45	2,973.04	621.62	84.40	540.77	1,273.98	14,364.08	391.66	24.28
Nov.7/81	1,272.83	1,622.89	5,346.40	283.53	150.00	536.45	1,378.53	1,750.19		541.14	1,319.01	14,200.97	788.88	18.00
Nov.14/81	1,208.75	1,539.36	5,346.40	283.53	150.00	536.45	1,190.97	826.84		531.14	1,285.65	12,899.09	695.46	18.55
Nov.21/81	1,151.35	1,476.66	4,459.10	283.53	150.00	536.45	1,190.97	1,788.94	316.40	1,571.78	1,102.50	14,027.68	570.00	24.57
Totals	17,763.87	24,805.54	83,601.26	4,479.70	2,370.00	9,147.61	19,128.12	24,468.90	1,889.35	10,139.34	12,950.24	212,762.93	10,825.44	19.65

TABLE 3
COST TABLE
FRENCHMAN'S INTEGRATED LOGGING OPERATIONS 1981

Week Ending	Chipper	Chip Trucks	Skidders	Bus	Shunter	Super-visor	Road Maint	Fuels & Lubes	Supplies	Misc	Benefits	Totals	Total Tonage	Cost Ton
Oct. 3/81	1,029.87	2,548.69	5,128.64	283.53	150.00	536.45	1,431.10	1,264.07		604.65	1,460.65	14,437.65	494.68	29.19
Oct.10/81	502.81	1,511.23	3,749.28	226.82	120.00	536.45	1,141.60	2,415.49		461.97	1,123.57	11,789.22	180.70	65.24
Oct.17/81	644.34	1,300.02	3,087.24	170.12	90.00	550.05	684.96	434.95		336.69	838.52	8,136.89	276.46	29.43
Oct.24/81	571.60	745.40	3,137.20	170.12	90.00	536.45	1,246.48	1,504.45		370.53	870.18	9,242.41	207.60	44.52
Totals	2,748.62	6,105.34	15,102.36	850.59	450.00	2,159.40	4,504.14	5,618.96		1,773.84	4,292.92	43,606.17	1,159.44	37.61

TABLE 4
COST TABLE
RED CLIFF CHIPPING STOCKPILED WOOD 1982
MIXEDWOOD

Week Ending	Chipper	Chip Trucks	Skidders	Bus	Shunter	Super-visor	Road Maint	Fuels & Lubes	Supplies	Misc	Benefits	Totals	Total Tonage	Cost Ton
Jan. 9/82	760.14	1,397.36	38.00		150.00	536.45	1,184.49	590.15		150.51	457.76	5,264.86	290.64	18.11
Jan. 16/82	679.78	1,067.61	38.00		90.00	536.45	1,251.83	2,138.98		487.65	375.64	6,665.94	259.50	25.69
Jan. 23/82	642.06	1,186.63	38.00		90.00	550.05	930.90	347.67		118.32	377.18	4,280.81	238.74	17.93
Jan. 30/82						536.45		94.25			37.48	668.18	Not Available	
Feb. 6/82	1,406.30	1,882.04	38.00		150.00	536.45	2,092.89	2,031.36		164.43	480.74	8,782.21	560.52	15.67
Feb. 13/82	394.42	316.95	7.60			161.69	351.20	221.35		42.63	116.45	1,612.29	124.56	12.94
Feb. 20/82	588.76	696.97	15.20		180.00	536.36	625.20	222.31		73.95	220.76	3,079.51	176.46	17.45
Totals	4,471.46	6,547.56	174.80		660.00	3,313.90	6,436.51	5,646.07		1,037.49	2,066.01	30,353.80	1,650.42	18.39

*The cutting and hauling cost brought over from 1981 is $10/tonne which produces a total cost for this operation of:

chipping and transportation	$30,353.80
cutting and hauling = $10/tonne x 1650.42 tonne =	16,504.20
	$46,858.00

TABLE 5
COST TABLE
STONEY BROOK OPERATIONS 1982
CHIPPING PURE BIRCH STANDS

Week Ending	Chipper	Chip Trucks	Skidders	Bus	Shunter	Super-visor	Road Maint	Fuels & Lubes	Supplies	Misc	Benefits	Totals	Total Tonage	Cost Ton
Jul. 3/82		-	2,087.28	26.85		45.60		297.72		125.28	311.92	2,894.55	Not available	
Jul.10/81	1,215.74	1,384.74	4,107.92	44.75	150.00	650.85	1,302.48	1,942.69			980.12	11,779.29	620	19.00
Jul.17/82	898.30	971.93	4.828.32	261.97	90.00	559.65	1,273.24	373.12		456.99	1,039.35	10,752.87	570	18.87
Jul.24/82			2,250.08	193.28		91.20		111.34		140.07	389.50	3,175.47	Not available	
Jul.31/82	691.56	762.91	3,038.69	316.28	90.00	544.45	796.08	2,722.74		267.96	720.81	9,951.48	360	27.64
Aug. 7/82			2,319.20	316.28				50.28		143.55	398.03	3,227.34	Not available	
Aug.14/82	1,208.40	1,303.90	3,246.88	361.28	120.00	.544.45	1,056.51	728.25		317.12	880.94	9,767.73	700	13.89
Adjustments								287.62				287.62		
Totals	4,014.00	4,423.48	21,878.37	1,520.69	450.00	2,436.20	4,428.31	6,513.76		1,450.97	4,720.67	51,836.45	2,250	23.04

TABLE 5
(Cont'd)

Week Ending	Chipper	Chip Trucks	Skidders	Bus	Shunter	Super-visor	Road Maint.	Fuels & Lubes	Misc.	Benefits	Totals	Total Tonage	Cost Tonne
Aug. 21/82	1,646.50	1,731.88	2,676.72	316.28	150.00	544.45	1,266.00	2,898.48	1,935.68	1,660.62	14,826.61	870	17.56
Aug. 28/82	1,550.50	1,659.88	3,373.12	316.28	150.00	631.25	1,266.00	665.88	2,151.36	1,717.41	13,481.68	940	14.06
Sept. 4/82	1,486.50	1,611.88	3,099.36	316.28	150.00	600.85	1,273.24	2,842.95	2,234.00	1,817.94	15,433.00	850	18.68
Sept.11/82	1,208.40	1,303.90	2,238.08	253.02	120.00	585.65	1,012.80	880.42	1,787.20	1,427.56	10,817.03	650	17.33
Sept.18/82	1,454.50	1,587.88	3,075.36	316.28	150.00	600.85	393.24	2,710.22	2,234.00	1,817.95	14,340.28	820	18.03
Sept.25/82	1,486.50	1,611.88	3,522.00	316.28	150.00	600.85	1,013.00	1,210.65	2,234.00	1,892.04	14,037.20	830	17.45
Oct. 2/82	1,255.14	1,433.89	3,522.00	316.28	150.00	600.85	1,139.40	3,023.11	2,234.00	1,819.93	15,494.60	700	22.42
Oct. 9/82	1,166.50	1,491.88	3,522.00	316.28	150.00	600.85	1,280.48	414.65	2,234.00	1,860.53	13,037.17	620	21.03
Oct. 16/82	1,373.30	1,570.90	3,099.36	316.28	150.00	600.85	1,280.48	3,390.31	2,234.00	1,770.25	15,695.73	770	20.38
Oct. 23/82	1,422.50	1,690.90	3,099.36	316.28	150.00	600.85	1,012.60	904.57	2,234.00	1,731.19	13,162.25	810	16.25
Oct. 30/82	1,422.50	1,611.88	2,958.48	279.48	150.00	600.85	1,269.48	2,662.56	2,234.00	1,758.91	14,968.14	720	20.79
Nov. 6/82	1,486.50	1,611.88	3,522.00	242.68	150.00	600.85	1,266.00	2,546.82	2,234.00	1,856.28	15,516.01	800	19.40
Nov. 13/82	1,422.50	1,577.93	3,460.37	316.28	150.00	600.85	1,266.00	678.11	2,234.00	1,849.32	13,555.36	740	18.32
Nov. 20/82	-	-	-	-	-	314.91	-	418.65	-	25.19	758.75	-	-
Nov. 27/82	1,294.50	1,467.88	3,048.24	316.28	150.00	600.85	1,294.95	2,757.99	1,862.80	1,689.85	14,483.34	570	25.41
Dec. 3/82*	1,422.50	1,611.88	3,099.36	316.28	150.00	524.85	1,012.60	2,184.00	2,059.21	1,199.20	13,579.88	750	18.10
Dec. 11/82*	1,618.34	1,807.72	3,522.00	316.28	150.00	524.85	1,280.48	1,916.00	2,234.00	1,331.81	14,701.48	920	15.98
TOTALS	26,731.18	29,807.52	72,716.18	6,407.51	2,820.00	12,171.51	22,755.06	38,549.13	35,821.22	31,946.65	279,725.96	14,610	19.14

* Adjustments

TABLE 6
COST TABLE
HYDRO-AX - CHOKER SKIDDER
TRIAL 1983

Week Ending	Chipper	Chip Trucks	Skidders & Hydro-Ax	Bus	Shunter	Super-visor	Road Maint.	Fuels & Lubes	Misc	Benefits	Totals	Total Tonage	Cost Tonne
Feb. 12/83	1,405	1,794	5,230	70	150	605	154	1,089	252	1,721	12,470	870	14.33
Feb. 14/83	1,486	1,612	6,986	206	150	601	593	3,328	1,117	1,356	17,435	900	19.37
Feb. 26 & Mar. 5/83	1,902	3,361	6,012	387	270	-	2,317	3,208	377	2,546	20,380	900	22.64
Mar. 12/83	938	1,130	4,031	506	150	-	991	1,670	284	1,319	11,019	610	18.06
TOTALS	5,731	7,897	22,259	1,169	720	1,206	4,055	9,295	2,030	6,942	61,304	3,280	18.69

TABLE 1
CHIPPING PURE BIRCH STANDS
WITH MODIFIED DUMP TRUCKS 1982

Date	Hours Scheduled	Total Downtime	Waiting Time For Trucks	Tonage	Cost Per Tonne	Tonnes/ Prod. Hr.
July 10/82	32	9	2.1	620	19.00	28.2
July 17/82	40	15	2.1	570	18.87	22.8
July 31/82	40	25	2.1	360	27.64	24.0
Aug. 14/82	40	13	2.1	700	13.89	25.9
Aug. 21/82	40	2	2.1	870	17.56	22.9
Aug. 28/82	40	5	2.1	940	14.06	26.9
Sept. 4/82	40	7	2.1	850	18.68	25.6
AVERAGES	38.9	10.9	2.1*	701.43	18.53	25.1

*Average waiting time for trucks in 1981 and 1982 $\frac{100 \text{ hrs.}}{48\text{wks Production}}$ = 2.1 Hrs.

TABLE 2
CHIPPING IN PURE BIRCH STANDS
WITH DUMPER AND VANS 1984

Date	Hours Scheduled	Hours Available	Hours Worked	Waiting Time For Trucks	Tonage	Total Cost	Cost Per Tonne	Tonnes/ Prod. Hr.
June 16/84	32	32	24	8	506	8,571.74	16.95	21.1
June 22/84	40	32	24	4	594	7,273.94	12.25	24.8
June 30/84	40	36	28	4	638	7,625.41	11.95	22.8
July 7/84	32	21	18	0	352	6.131.61	17.42	19.5
July 14/84	40	35	22	4	484	7.505.03	15.51	22.0
July 21/84	40	38	26	6	464	7,644.35	16.47	17.8
July 28/84	40	38	28	6	600	8,639.64	14.40	21.4
Aug. 4/84	40	4	4	0	66	2,019.37	30.60	16.5
Aug. 11/84	40	24	18	3	374	6,685.37	17.88	20.8
Aug. 18/84	40	12	10	0	186	3.731.00	20.06	18.6
Sept. 1/84	40	32	25	3	430	6.595.74	15.34	17.2
AVERAGES	38.6	27.6	20.6	3.5	426.73	6.583.93	15.43	20.7

APPENDIX D

1982 YEAR-END STATEMENT

AMMJ3-30-193

ABITIBI-PRICE INC.
NEWFOUNDLAND WOODLANDS
BIRCH CHIPPING PROJECT AS AT DECEMBER 82

MONTH TONS	MONTH AMOUNT	MONTH UNIT		TO-DATE TONS	TO-DATE AMOUNT	TO-DATE UNIT
			CHIPPING			
3,070			RED CLIFF INVENTORY	18,611	84,000	4.51
3,070	9,814	3.20	WAGES	18,611	110,955	5.96
3,070	2,345	.76	WAGE SUPPLEMENT	18,611	11,529	.62
3,070	2,624	.85	SALARIES	18,611	21,977	1.18
3,070	18,740	6.11	EQUIPMENT HIRE	18,611	117,718	6.33
3,070	655	.21	SUPPLIES	18,611	3,106	.17
3,070	1,814	.59	POWER SAW HIRE	18,611	8,424	.45
3,070	2		MEALS	18,611	2	
3,070	7,705	2.57	FUELS & LUBRICANTS	18,611	41,894	2.25
3,070	1,251	.41	PRIVATE VEHICLE HIRE	18,611	11,975	.64
3,070	7,108	2.32	FRINGE BENEFITS	18,611	34,461	1.85
3,070			OTHER	18,611	1,299	.07
3,070	4,823	1.57	EQUIPMENT	18,611	4,823	.26
3,070	56,769	18.49	SUB-TOTAL	18,611	451,863	24.28
			REPAIRS TO CHIPPER/ESTER			
3,070			WAGES	18,611	3,078	.17
3,070			WAGE SUPPLEMENT	18,611	141	.01
3,070			SALARIES	18,611	4,393	.24
3,070	254	.08	EQUIPMENT HIRE	18,611	802	.04
3,070	348	.11	SUPPLIES	18,611	1,570	.08
3,070			MEALS	18,611	69	
3,070	2,377	.77	REPAIR PARTS	18,611	20,238	1.09
3,070			PRIVATE VEHICLE HIRE	18,611	502	.03
3,070			OUTSIDE REPAIRS & MTCE.	18,611	3,606	.19
3,070			TIRES & TUBES	18,611		
3,070	494	.16	FIELD MTCE. TRANSFER	18,611	12,556	.67
3,070	3,616-	1.18-	HIRE CREDIT	18,611	27,223-	1.46-
3,070	151-	.05-	SUB-TOTAL	18,611	19,726	1.06
			REPAIRS TO CHIP TRUCKS			
3,070	478	.16	WAGES	18,611	2,550	.14
3,070	42	.01	WAGE SUPPLEMENT	18,611	125	.01
3,070	237	.08	EQUIPMENT HIRE	18,611	237	.01
3,070	983	.32	SUPPLIES	18,611	7,857	.42
3,070			FUELS & LUBRICANTS	18,611	496	.03
3,070	4,994	1.63	REPAIR PARTS	18,611	12,525	.67
3,070	530	.17	OUTSIDE REPAIRS & MTCE.	18,611	717	.04
3,070			TIRES & TUBES	18,611	7,370	.40
3,070	4,550	1.48	FIELD MTCE TRANSFER	18,611	20,932	1.12
3,070	2,880-	.94-	HIRE CREDITS	18,611	29,873-	1.61-
3,070			LICENSES	18,611	1,200	.06
3,070	8,941	2.91	SUB-TOTAL	18,611	24,489	1.29
3,070	65,559	21.35	SUB-TOTAL	18,611	495,718	26.64
4,145	99,203	23.94	EXTERNAL CHIPS	4,145	99203	23.94
7,215	197,401-	27.36-	REVENUE	22,756	590,331-	25.50-
7,215	32,599	4.52-	TOTAL	22,756	14,630	.64

APPENDIX E

COST PROJECTION FOR

HYDRO-AX/GRAPPLE SKIDDER OPERATION

ABITIBI-PRICE INC.

WOODLANDS' DIVISION

BIRCH CHIPPING COST

	5 Skidders Skidder To Chipper Period	2 Hydro-Ax Grapple Sk. to Ch. Todate
Foreman	525	525
Trucking	750	750
Tractor Operator	386	386
Skidding	3178	N.L
Chipping	394	394
Transportation of Men	70	70
Hydro-Ax + Grapple Skidder Opers.		1172
C.O.L.A.	492	257
Hydro-Ax 2 @ 1670/week	N.L	3340
Fringe Benefit	1314	701
Supplies 750 Tons @ .25/ton	188	N.L
Truck Hire	960	960
Chipper Hire 80% availability	1024	1024
Skidder Hire	600	N.L
Saws 240 hrs x $1.05	252	N.L
Tractor	880	880
Bus & Pickup	138	138
Shunter	150	150
Fuel	2185	2390
Grapple Skidder	N.L	1174
TOTAL COST	15073	14311
TONS Based on 15 loads/day	750	750
COST/TON	20.11	19.08

APPENDIX F

PURCHASE COST OF

CHIPVAN DUMPER

MORBARK INDUSTRIES, INC.

WINN, MICHIGAN 48896 • 517-866-2381 • TELEX 227 443 (MORBARK WINN)

September 15, 1982

Mr. Harvey G. Taylor
ABITIBI-PRICE, INC.
P.O. Box 500
Grand Falls, NFLD CANADA
A2A 2K1

Dear Harvey:

We are pleased to acknowledge receipt of your Purchase Order #GF 005232 W. Please confirm that your equipment is to be manufactured as follows:

One (1) MORBARK HYDRAULIC DUMP
Complete with main lift cylinders, attachment chains and pivoting cradle
-Foundation Kit

One (1) MORBARK 50-HP, 75 GALLON PUMP STAND
Complete with 2620 V 12A-12 double pump with control valves, 75 gallon tank, 50-HP electric motor, motor base and drive (includes all belts, sheaves and bushings)
-575 Volt Starter

Total Cost of Equipment:	$33,120.00
Approx. Freight to Newfoundland	5,000.00
BALANCE DUE	$38,120.00

This balance due is payable 2%-10/Net 30 Days. Any sales, use or other type of tax is the responsibility of the buyer. This unit carries our standard 90 day warranty.

Any changes from the information as listed in the previous paragraphs should be specified below. Please sign and return the ORIGINAL of this letter in the enclosed envelope.

Thank you for your order. Should you have any questions, please call me.

Sincerely,

MORBARK INDUSTRIES, INC.

Jerry Morey
Sales Manager

JM/vd

Signature

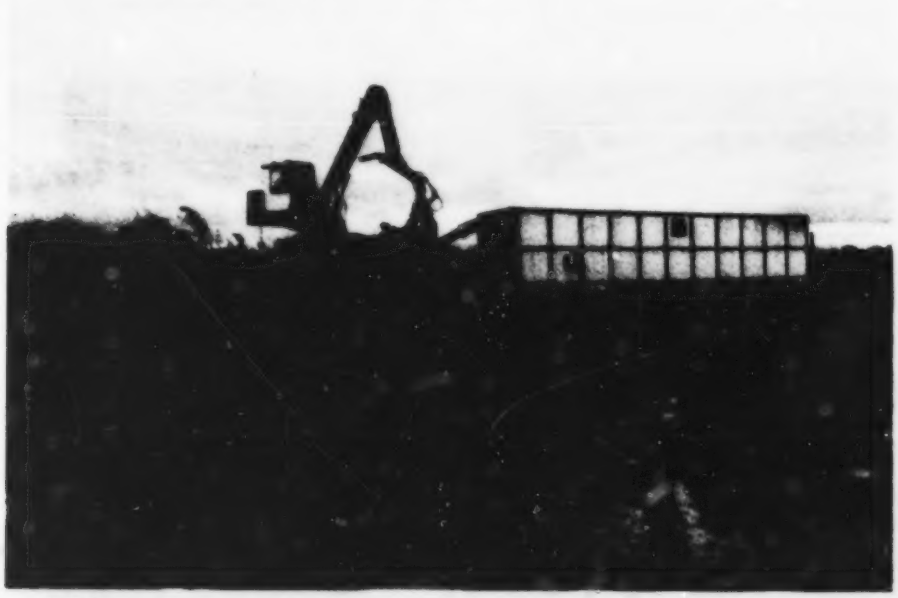
Date

"With Pride In Performance"

APPENDIX G

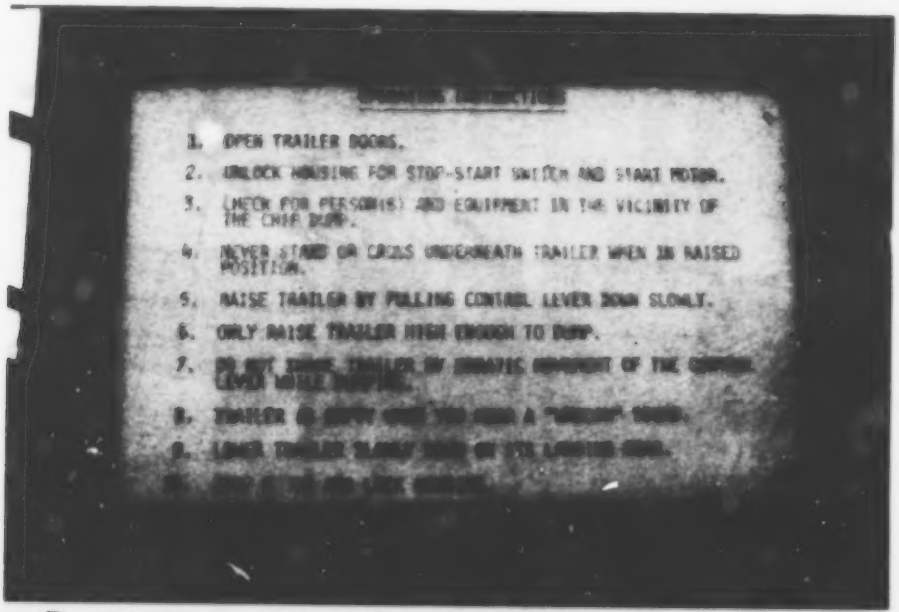
PHOTOGRAPHS

The original transportation system used modified dump trucks, which could carry 10 tonnes of chips. Loading at the chipping site was as below.



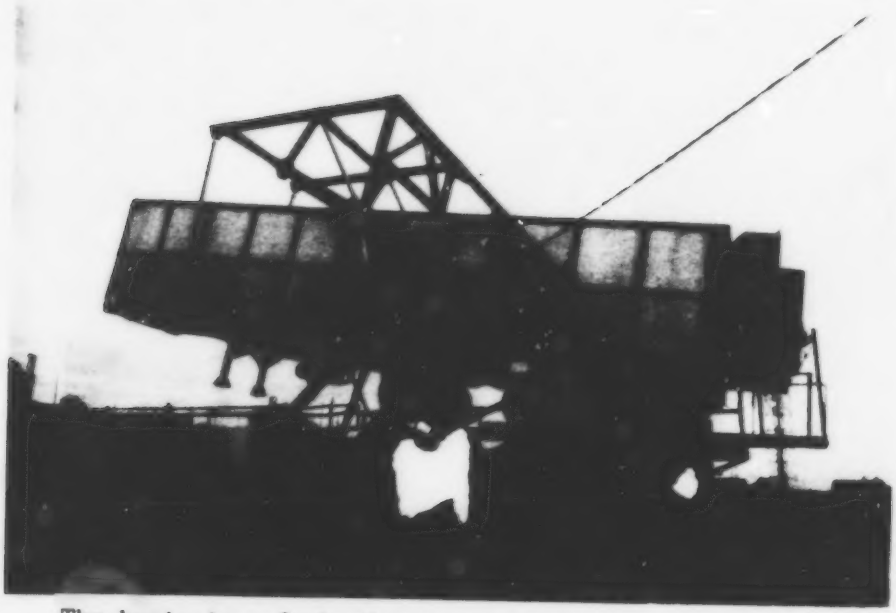
A 20-tonne capacity tractor-trailer chipvan being loaded at the chipping site.

The tractor is disconnected, and the lifting chains attached to the trailer

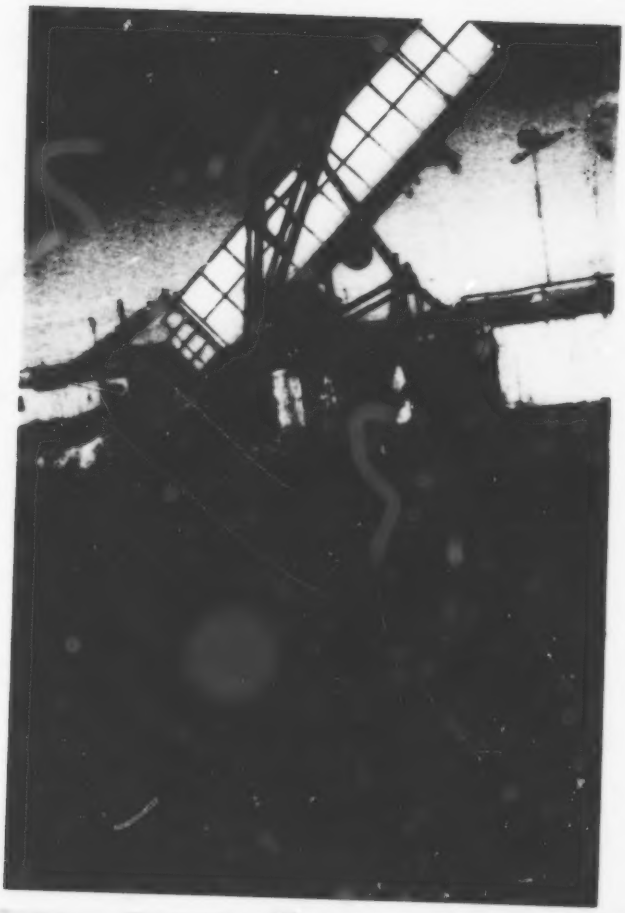

1. OPEN TRAILER DOORS.
2. UNLOCK HOUSING FOR STOP-START SWITCH AND START MOTOR.
3. CHECK FOR PERSON(S) AND EQUIPMENT IN THE VICINITY OF THE CHIP DUMP.
4. NEVER STAND OR CROSS UNDERNEATH TRAILER WHEN IN RAISED POSITION.
5. RAISE TRAILER BY PULLING CONTROL LEVER DOWN SLOWLY.
6. ONLY RAISE TRAILER HIGH ENOUGH TO DUMP.

The operating instructions for the trailer dumper. The driver usually operated the dumper.

The motor, hydraulic pump and single operating lever.



The beginning of the dumping operation.



The dumper at full extension, showing a full load being dumped.

A swinging platform is provided to allow the operator to open and close the trailer doors.